CLAIMS

1. A lead frame for a semiconductor device, the lead frame comprising:

a sheet having oppositely facing sides and a thickness between the oppositely facing sides,

the sheet comprising first and second unit lead frames,

each said unit lead frame comprising a support for a semiconductor chip and at least one lead spaced from the support,

the sheet further comprising a tie bar network which connects a) the support to the at least one lead on each of the first and second unit lead frames and b) the first and second unit lead frames each to the other,

the sheet having a dividing line along which the sheet can be cut to separate the first and second unit lead frames from each other,

the tie bar network comprising at least one tie bar extending along a substantial length of the dividing line,

the support having a first thickness between the oppositely facing sides of the sheet,

the at least one tie bar having a second thickness between the oppositely facing sides of the sheet over a substantial length of the dividing line that is less than the first thickness.

2. The lead frame for a semiconductor device according to claim 1 wherein the base on the first unit lead frame has a polygonal shape with an outer edge defined by a plurality of straight edge portions, the dividing line is substantially straight and has a length and is spaced from and extends substantially parallel to one of the straight edge portions, and the at least one tie bar has a thickness between the oppositely facing sides of the sheet that is less than the first thickness over substantially the entire length of the dividing line.

3. The lead frame for a semiconductor device according to claim 1 wherein the first unit lead frame has a corner, and the tie bar network comprises a support tie bar assembly comprising at least one support tie bar that extends from the support on the first unit lead frame towards the corner.

4. The lead frame for a semiconductor device according to claim 3 wherein the first unit lead frame has first and second peripheral tie bars that meet at the corner and the support tie bar assembly branches away from the support on the first unit lead frame to define a first support tie bar that extends to the first peripheral tie bar and a second support tie bar that extends to the second peripheral tie bar.

5. The lead frame for a semiconductor device according to claim 4 wherein the support tie bar assembly has a length and a thickness between the oppositely facing sides of the sheet that is less than the first thickness over at least a portion of the length of the support tie bar assembly .

6. The lead frame for a semiconductor device according to claim 3 wherein the at least one support tie bar has a discrete opening therethrough.

7. The lead frame for a semiconductor device according to claim 6 wherein the discrete opening is fully surrounded by the at least one support tie bar.

8. The lead frame for a semiconductor device according to claim 7 wherein the discrete opening is an elongate opening.

9. The lead frame for a semiconductor device according to claim 1 wherein at least one lead on at least one of the unit lead frames has an undercut formed therein.

10. The lead frame for a semiconductor device according to claim 1 wherein said first and second unit lead frames each have a rectangular shape with a peripheral edge defined by first, second, third and fourth peripheral edge portions, the support on the first unit lead frame has a rectangular shape defined by first, second, third, and fourth outer edges, the first, second, third and fourth peripheral edge portions are substantially parallel to the first, second, third, and fourth outer edges and there are a plurality of leads between the first peripheral edge portion and the first outer edge, the second peripheral edge portion and the second outer edge, the third peripheral edge portion and the third outer edge, and the fourth peripheral edge portion and the fourth outer edge.

11. The lead frame for a semiconductor device according to claim 1 wherein the sheet comprises a border rail, the tie bar network connects the first unit lead frame to the border rail, and the first unit lead frame has a peripheral edge connected to the border rail through the tie bar network.

12. The lead frame for a semiconductor device according to claim 11 wherein the sheet has a second dividing line along the peripheral edge along which the sheet can be cut to separate the first unit lead frame from at least a part of the border rail, and the tie bar network comprises at least a second tie bar extending along a substantial length of the second dividing line, the at least second tie bar having a thickness between the oppositely facing sides of the sheet over a substantial length of the second dividing line that is less than the first thickness.

13. The lead frame for a semiconductor device according to claim 11 wherein the sheet has a second dividing line along the peripheral edge along which the sheet can be cut to separate the first unit lead frame from at least a part of the border rail, the support on the first unit lead frame is on a first side of the

second dividing line and the at least part of the border rail is on a second side of the second dividing line, and the at least one lead on the first unit lead frame and the tie bar network are sufficiently symmetrical at the first and second sides of the second dividing line that resistance to cutting along the second dividing line at the first and second sides is substantially the same.

14. The lead frame for a semiconductor device according to claim 5 wherein the support tie bar assembly extends to the corner at which the first and second peripheral tie bars meet and the sheet at the corner at which the first ands second peripheral tie bars meet has a thickness that is less than the first thickness.

15. The lead frame for a semiconductor device according to claim 1 wherein at least one of the oppositely facing sides of the sheet is formed to produce the second thickness.

16. The lead frame for a semiconductor device according to claim 15 wherein at least one of the oppositely facing sides is formed by one of etching and compression.

17. The lead frame for a semiconductor device according to claim 15 wherein the sheet comprises a border rail, the first unit lead frame has a peripheral edge defined by a plurality of peripheral edge portions, the tie bar network and the at least one lead extends continuously around the first unit lead frame so as to connect the first unit lead frame to a) the second unit lead frame, b) the border rail and c) at least a third unit lead frame, and the tie bar network has at least a portion with a thickness less than the first thickness extending substantially fully around the peripheral edge of the first unit lead frame.

18. The lead frame for a semiconductor device according to claim 17 wherein the at least one lead has a portion with a thickness that is less than the first thickness.

19. The lead frame for a semiconductor device according to claim 18 wherein the tie bar network has a thickness less than the first thickness extending continuously fully around the first unit lead frame.

20. A semiconductor assembly comprising:

a) a lead frame comprising:

a sheet having oppositely facing sides and a thickness between the oppositely facing sides,

the sheet comprising first and second unit lead frames,

each said unit lead frame comprising a support for a semiconductor chip and at least one lead spaced from the support,

the sheet further comprising a tie bar network which connects a) the support to the at least one lead on each of the first and second unit lead frames and b) the first and second unit lead frames each to the other,

the sheet having a dividing line along which the sheet can be cut to separate the first and second unit lead frames from each other,

the tie bar network comprising at least one tie bar extending along a substantial length of the dividing line,

the support having a first thickness between the oppositely facing sides of the sheet,

the at least one tie bar having a second thickness between the oppositely facing sides of the sheet over a substantial length of the dividing line that is less than the first thickness;

b) a first semiconductor chip applied to the support on the first unit lead frame;

c) a first conductive element electrically connecting the first semiconductor chip to the at least one lead on the first unit lead frame;

d) a second semiconductor chip applied to the support on the second unit lead frame;

e) a second conductive element electrically connecting the second semiconductor chip to the at least one lead on the second unit lead frame; and

f) a resin layer applied over one of the oppositely facing sides of the sheet so as to be applied to the first and second semiconductor chips and the first and second conductive elements.

21. The semiconductor assembly according to claim 20 wherein the base on the first unit lead frame has a polygonal shape with a peripheral edge defined by a plurality of straight edge portions, the dividing line is substantially straight and has a length and is spaced from and extends substantially parallel to one of the straight edge portions, and the at least one tie bar has a thickness between the oppositely facing sides of the sheet that is less than the first thickness over substantially the entire length of the dividing line.

22. The semiconductor assembly according to claim 20 wherein the first unit lead frame has a corner, and the tie bar network comprises a support tie bar assembly comprising at least one support tie bar that extends from the support on the first unit lead frame towards the corner.

23. The semiconductor assembly according to claim 22 wherein the first unit lead frame has first and second peripheral tie bars that meet at the corner and the support tie bar assembly branches away from the support on the first unit lead frame to define a first support tie bar that extends to the first tie bar and a second support tie bar that extends to the second peripheral tie bar.

24. The semiconductor assembly according to claim 23 wherein the support tie bar assembly has a length and a thickness between the oppositely facing sides of the sheet that is less than the first thickness over at least a portion of the length of the support tie bar assembly .

25. The semiconductor assembly according to claim 22 wherein the at least one support tie bar has a discrete opening therethrough.

26. The semiconductor assembly according to claim 25 wherein the discrete opening is fully surrounded by the at least one support tie bar.

27. The semiconductor assembly according to claim 26 wherein the discrete opening is an elongate opening.

28. The semiconductor assembly according to claim 20 wherein at least one lead on at least one of the unit lead frames has an undercut formed therein.

29. The semiconductor assembly according to claim 20 wherein said first and second unit lead frames each have a rectangular shape with a peripheral edge defined by first, second, third and fourth peripheral edge portions, the support on the first unit lead frame has a rectangular shape defined by first, second, third, and fourth outer edges, the first, second, third and fourth peripheral edge portions are substantially parallel to the first, second, third, and fourth outer edges and there are a plurality of leads between the first peripheral edge portion and the first outer edge, the second peripheral edge portion and the second outer edge, the third peripheral edge portion and the third outer edge, and the fourth peripheral edge portion and the fourth outer edge.

30. The semiconductor assembly according to claim 20 wherein the sheet comprises a border rail, the tie bar network connects the at least first unit lead frame to the border rail, and the first unit lead frame has a peripheral edge portion connected to the border rail through the tie bar network.

31. The semiconductor assembly according to claim 30 wherein the sheet has a second dividing line along the peripheral edge along which the sheet

can be cut to separate the first unit lead frame from at least a part of the border rail, and the tie bar network comprises at least a second tie bar extending along a substantial length of the second dividing line, the at least second tie bar having a thickness between the oppositely facing sides of the sheet over a substantial length of the second dividing line that is less than the first thickness.

32. The semiconductor assembly according to claim 30 wherein the sheet has a second dividing line along the peripheral edge along which the sheet can be cut to separate the first unit lead frame from at least a part of the border rail, the support on the first unit lead frame is on a first side of the second dividing line and the at least part of the border rail is on a second side of the second dividing line, and the at least one lead on the first unit lead frame and the tie bar network are sufficiently symmetrical at the first and second sides of the second dividing line that resistance to cutting along the second dividing line at the first and second sides is substantially the same.

33. The semiconductor assembly according to claim 24 wherein the support tie bar assembly extends to the corner at which the first and second

peripheral tie bars meet and the sheet at the corner at which the first and second peripheral tie bars meet has a thickness that is less than the first thickness.

34. The semiconductor assembly according to claim 20 wherein at least one of the oppositely facing sides of the sheet is formed to produce the second thickness.

35. The semiconductor assembly according to claim 34 wherein at least one of the oppositely facing sides is formed by one of etching and compression.

36. The semiconductor assembly according to claim 34 wherein the sheet comprises a border rail, the first unit lead frame has a peripheral edge defined by a plurality of peripheral edge portions, the tie bar network and the at least one lead extends continuously around the first unit lead frame so as to connect the first unit lead frame to a) the second unit lead frame, b) the border rail and c) at least a third unit lead frame, and the tie bar network has at least a portion with a thickness less than the first thickness extending substantially fully around the peripheral edge of the first unit lead frame.

37. The semiconductor assembly according to claim 36 wherein at least one lead has a portion with a thickness that is less than the first thickness.

38. The semiconductor assembly according to claim 37 wherein the tie bar network has a thickness less than the first thickness extending continuously fully around the first unit lead frame.

39. A method of forming a semiconductor device, said method comprising the steps of:

A) providing a semiconductor assembly comprising:

i) a lead frame comprising:

a sheet having oppositely facing sides and a thickness between the oppositely facing sides,

the sheet comprising first and second unit lead frames,

each said unit lead frame comprising a support for a semiconductor chip and at least one lead spaced from the support,

the sheet further comprising a tie bar network which connects a) the support to the at least one lead on each of the first and second unit lead frames and b) the first and second unit lead frames each to the other,

the sheet having a dividing line along which the sheet can be cut to separate the first and second unit lead frames from each other,

the tie bar network comprising at least one tie bar extending along a substantial length of the dividing line,

the support having a first thickness between the oppositely facing sides of the sheet,

the at least one tie bar having a second thickness between the oppositely facing sides of the sheet over a substantial length of the dividing line that is less than the first thickness;

ii) a first semiconductor chip applied to the support on the first unit lead frame;

iii) a first conductive element electrically connecting the first semiconductor chip to the at least one lead on the first unit lead frame;

iv) a second semiconductor chip applied to the support on the second unit lead frame;

v) a second conductive element electrically connecting the second semiconductor chip to the at least one lead on the second unit lead frame; and

vi) a resin layer applied over one of the oppositely facing sides of the sheet so as to be applied to the first and second semiconductor chips and the first and second conductive elements; and

B) forming a first semiconductor device by cutting through the resin layer and the lead frame around the first unit lead frame including along the dividing line.

40. A semiconductor device comprising:

a sheet portion defining a unit lead frame with oppositely facing sides and a thickness between the oppositely facing sides of the sheet portion,

the unit lead frame comprising a support having a first thickness between the oppositely facing sides of the sheet portion,

the unit lead frame further comprising at least one lead and a tie bar network comprising a plurality of elongate tie bars each with a length,

the tie bar network connecting the support to the at least one lead;

a semiconductor chip on the support;

a conductive element electrically connecting the semiconductor chip to the at least one lead; and

a resin layer applied over the semiconductor chip, the conductive element and at least a part of one of the oppositely facing sides of the sheet portion,

the semiconductor device having a peripheral edge comprising a plurality of straight edge portions defining a polygonal shape,

a plurality of the peripheral edge portions formed by cutting to expose a part of the tie bar network,

a first plurality of the elongate tie bars each having a substantial length that has a thickness between the oppositely facing sides of the sheet that is less than the first thickness.